

San Luis Obispo Creek
Priority Organics Listing-
Problem Statement and Clarification of Listing
July 25, 2001

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1. Introduction

A Total Maximum Daily Load (TMDL) is required for waters listed as impaired pursuant to Section 303(d) of the Clean Water Act. The 303(d) list identifies water bodies or segments that do not meet water quality objectives, or are not expected to meet water quality objectives after technology-based effluent limitations are applied.

San Luis Obispo Creek was placed on the 303(d) list in 1998 for ‘Priority Organics.’ This document is a Problem Statement and clarification of the listing, resulting in a listing of ‘Polychlorinated Biphenyl (PCB).’

Data from 1990 and 1991 indicated elevated levels of hexachlorocyclohexane (HCH), chlordane, and PCB, which prompted the listing of priority organics. Staff have since revisited this data, and have determined that portions of it cannot be used as listing criteria. Furthermore, staff have since conducted monitoring in San Luis Obispo Creek and have determined water quality objectives are being met for HCH and chlordane.

1. Physical Setting

The San Luis Obispo Creek Watershed (Watershed) is located on the Central Coast of California, approximately 240 miles south of San Francisco and 200 miles north of Los Angeles. The Watershed encompasses 84.2 square miles (53,905 acres) and includes the intersection of three valleys. These valleys are Los Osos, Chorro, and Edna Valleys, and portions of the mountains that define them. The mountain ranges defining the Watershed are the Santa Lucia Mountains (eastern boundary of the Watershed), the Irish Hills (western boundary of the Watershed), and the Morros (separating Los Osos Valley and Chorro Valley). San Luis Obispo Creek (Creek) and its tributaries arise in the uplands of these mountains (up to 2,200-ft. elevation) and traverse portions of their respective valleys before emptying at San Luis Obispo Bay at Avila into the Pacific Ocean. The drainage pattern of the creeks in the Watershed is dendritic, with the Creek being the main watercourse for the Watershed. The main stem of the Creek is approximately 18 miles in length. The eleven major tributaries are:

- Brizziolari Creek
- Davenport Creek
- East Branch San Luis Obispo Creek
- Froom Creek
- Old Garden Creek
- Prefumo Creek
- Reservoir Canyon Creek
- San Miguelito Creek
- Squire Canyon Creek
- Stenner Creek
- Sycamore Creek

The Creek and its tributaries flow through various land uses, including: chaparral, oak woodlands, grassland and low-intensity rangeland, intensive animal feeding areas, irrigated cropland, vineyards and orchards, rural residential areas, and urban (residential and commercial) uses. Urban land uses are concentrated within the city limits of San Luis Obispo and on the campus of California Polytechnic State University, San Luis Obispo. Agricultural and rural land uses occur in the areas surrounding the City and on the Cal Poly campus. Irrigated agriculture tends to be concentrated in the flatter bottomlands. The steeper slopes tend to be either relatively undisturbed chaparral and woodland, or used as non-irrigated, low-intensity rangeland. Figure-1 below illustrates the location and pattern of San Luis Obispo Creek Watershed.

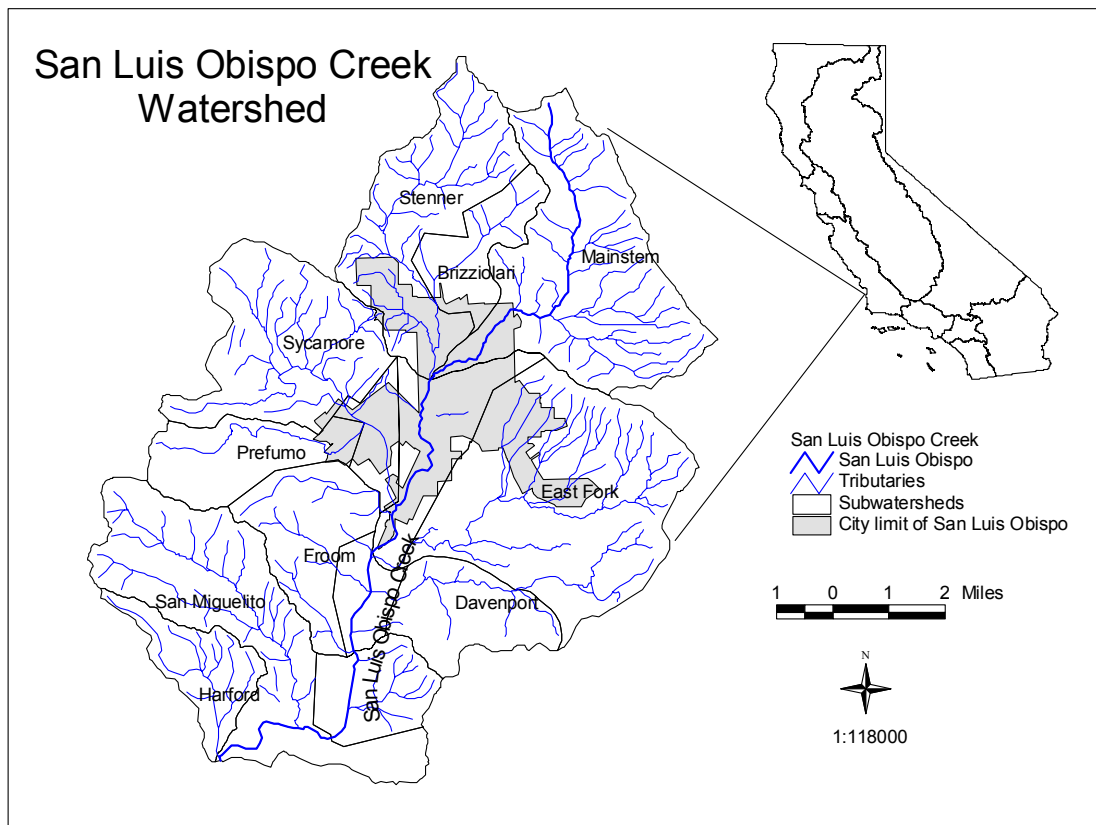


Figure-1. San Luis Obispo Creek Watershed

2. Beneficial Uses

The *Water Quality Control Plan Central Coast Basin – Region 3* (Basin Plan) adopted by the Regional Board and the State Water Resources Control Board (SWRCB) identifies the following beneficial uses for the waters of San Luis Obispo Creek and its tributaries:

- Municipal and Domestic Water Supply (MUN)
- Agricultural Supply (AGR)
- Ground Water Recharge (GWR)
- Water Contact Recreation (REC-1)

- Non-Contact Water Recreation (REC-2)
- Wildlife Habitat (WILD)
- Cold Freshwater Habitat (COLD)
- Warm Freshwater Habitat (WARM)
- Migration of Aquatic Organisms (MIGR)
- Spawning, Reproduction, and/or Early Developments (SPWN)
- Rare, Threatened, or Endangered Species (RARE)
- Freshwater Replenishment (FRSH)
- Commercial and Sport Fishing (COMM)

Of the identified beneficial uses, Central Coast Regional Water Quality Control Board staff (staff) have determined that Municipal and Domestic Water Supply (MUN), and Cold Freshwater Habitat (COLD) are the most sensitive to the effects of the organic constituents addressed in this document.

2. Problem Statement

a) Constituents of Concern

San Luis Obispo Creek was listed for priority organics because two tissue samples collected in 1990-1991 carried elevated levels of chlordane, HCH, and PCB. The following is a short discussion of each of these constituents. The discussion is provided to help build an understanding as to why chlordane and HCH no longer pose a risk to water quality in the Creek.

Chlordane was widely used in the United States from 1947 to 1988. The primary use of chlordane was for termite control, but was also used to protect crops from other soil-living pests. The toxicity of chlordane needs further research. However, EPA reports human short-term health effects to the central nervous system, and long-term effects of cancers to various parts of the body.¹ Chlordane bioaccumulates in aquatic organisms, and is considered highly toxic to them, as well as birds. Chlordane tends to adsorb to soil particles; its environmental fate is unclear, but through time can slowly leach into groundwater. EPA banned the use of chlordane on crops in 1978, and all commercial and domestic use in 1988.

PCB's began being used in the 1930's as a synthetic insulator in transformers. The product allowed the electrical engineer to place the transformer anywhere he/she wished because PCB's are fire-resistant. The uses of PCB's soon expanded to other industries where fire-retardant insulation was necessary. The manufacture of PCB's ceased in the late 1970's, but a large number of electrical units containing PCB's remained in operation, many of which were not labeled as containing the compound. Consequently, release of PCB's into the environment continued after the ban on manufacture. US EPA estimates that releases to the environment totaled 74,000 pounds between 1987 and 1993,

¹ <http://www.epa.gov/safewater/dwh/c-soc/chlordan.html>

with the bulk of the release occurring in 1990 in California.² Current releases are due mainly to cycling between soil and air. The health effects of PCB's include skin ailments, reproductive disorders, and liver disease. Furthermore, they are known to be carcinogenic to animals, and suspected to be to humans. PCB solubility in water diminishes through time, but is stored in the fatty tissues of animals and humans, and can bioaccumulate in food webs. Biodegradability is slow, they adsorb to soil particles, and persist in the environment.

HCH began being used as an insecticide on fruits and vegetables in the 1940's. There are several isomers of HCH (alpha, beta, delta, gamma), but only gamma-HCH is an effective insecticide. Consequently, products largely containing the gamma-HCH isomer were manufactured, marketed as Lindane, and became a primary source to the environment. HCH is still used by humans today (as Lindane) as a topical treatment to control lice, fleas, and scabies. HCH has not been manufactured in the U.S. since 1983, but is still imported. Exposure to HCH can cause blood disorders, dizziness, headaches, and seizures. Laboratory rodents exposed to prolonged high levels of HCH developed cancers, and HCH is therefore suspected of being a carcinogen to humans. HCH isomers can be present in vapor, attached to soil, or attached to dust particles. It is biodegraded by algae, fungi, and bacteria, and is broken down in water quickly; lindane breaks down in about a month.³ HCH bioaccumulates in the fatty tissues of fish.

3. Listing Rationale

Staff collected samples from the Creek in 1991 and 1990 through the State Mussel Watch and Toxic Substance Monitoring programs, respectively. Two of the tissue samples collected had elevated levels of chlordane, HCH, and PCB. Elevated levels of these constituents provided a basis for the listing of the Creek as impaired due to priority organics. However, priority organics, as outlined by US EPA, includes a suite of over 200 organic constituents, only three of which (i.e., chlordane, HCH, and PCB) were found in elevated concentrations in the Creek.

Tissue from a freshwater clam collected on February 26, 1991 contained PCB and chlordane at levels exceeding the Maximum Tissue Residue Level (MTRL) for those constituents. Tissue from a goldfish collected on July 25, 1990 contained PCB and HCH levels exceeding the 85th percentile of Elevated Data Levels (EDL) established for that data period. A short description of these criteria is necessary for context.

MTRLs are concentrations developed by State Water Resources Control Board staff to protect against consumption of fish and shellfish that contain substances potentially harmful to humans. The MTRL concentrations were calculated using existing water quality objectives and are "used as alert levels or guidelines indicating water bodies with potential human health concerns and are an assessment tool and not compliance or enforcement criteria."⁵ The units for MTRLs are expressed as mass of pollutant per mass of tissue, e.g. µg/kg.

² <http://www.epa.gov/safewater/dwh/c-soc/pcbs.html>

³ <http://www.atsdr.cdc.gov/tfacts43.html>

EDLs are a comparative tool developed by SWRCB staff to rank concentrations for a particular substance (pollutant) in a particular sample between other samples for the same substance. The EDL is obtained by producing a cumulative distribution of all the concentrations from various samples of a particular substance for a determined period of time. A sample having a particular concentration ranking in the 85th percentile implies that 85 percent of the samples analyzed for that substance showed equal or lower concentrations. The measure is used for internal comparative analysis only, “they (EDLs) do not assess adverse impacts, nor do they necessarily represent concentrations that may be damaging to the mussels, clams, or to a human consuming these species.”⁴

Table-1 lists the data point with constituents that exceeded the MTRL. Table-2 lists the data point with constituents that exceeded the EDL-85 level.

Table-1. Data exceeding MTRL.

Constituent	Date Sampled	Organism	Concentration (µg/L)	1987-1993 MTRL (µg/L)^a	1995-1997 MTRL (µg/L)^b
Total Chlordane	02/26/91	freshwater clam	17.5	1.2	8.3
Total PCB	02/26/91	freshwater clam	14.1	2.2	5.3

a. Numeric criteria for 1991 data point.³

b. Recent numeric criteria based on CTR values.⁴

Table-2. Data exceeding EDL-85

Constituent	Date Sampled	Organism	Concentration (µg/L)	EDL-85th Percentile^a	EDL-95th Percentile^b
Total HCH	07/25/90	goldfish	106.8	60.0	682.7
Total PCB	07/25/90	goldfish	9638.1	8521.3	40500.0

a. See Footnote 4 below.

b. See Footnote 4 below.

Note that Table-1 lists two exceedences of MTRL limits. The first is for chlordane, the second is for PCB. Table-2 lists two exceedences for the EDL-85th percentile. The first is for HCH, and the second is for PCB. Neither of the exceedences approached the EDL-95th percentile.

The listing rational for San Luis Obispo Creek for priority organics was based solely on these two data points and their exceedence of MTRL and EDL values.

⁴ State Water Resources Control Board-California Environmental Protection Agency. State Mussel Watch Program 1987-1993 Data Report. March 1995.

⁵ State Water Resources Control Board-California Environmental Protection Agency. State Mussel Watch Program 1995-1997 Data Report. September 2000.

4. Current Data

Staff conducted an assessment in April 2001 for the organics contained in EPA method 508 analysis, which includes chlordane, HCH, and PCB, as well as seventeen other organic constituents. Water column samples were collected from nine sites as illustrated in Figure-2 below. The 1990 and 1991 sampling points from the State Mussel Watch and Toxic Substance Monitoring Programs are also listed.

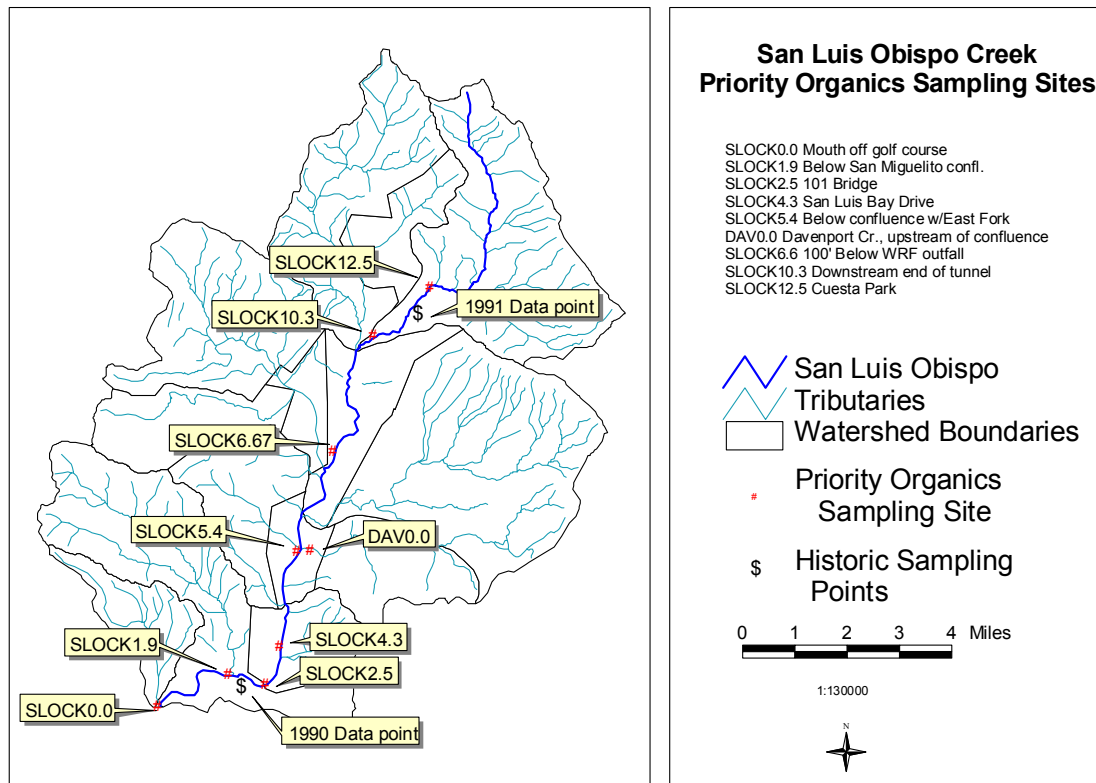


Figure-2. Map showing priority organics sampling sites during April 2001 assessment.

The Central Coast Ambient Monitoring Program (CCAMP) conducted sampling in the Creek in September 1999. CCAMP collected fish tissue for analysis of several constituents, including chlordane, HCH, and PCB. Tissue from twenty fish were collected from the site listed as SLOCK0.0 in Figure-2, combined into one sample, and analyzed for various constituents.

Table-3 below lists the results from the April 2001 sampling. Table-4 below lists the detection limit for the data in Table-3, as well as numeric objectives that apply.

Table 3. Data from April 2001 monitoring.

			ALPHA-BHC^a	BETA-BHC	DELTA-BHC	GAMMA-BHC	CHLORDANE	TOTAL-PCB
SITE	DATE	Matrix	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DAV0.0	04/27/01	aqueous	ND ^b	ND	ND	ND	ND	ND
SLOCK0.0	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK0.0	04/20/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK1.9	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK1.9	04/20/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK2.5	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK2.5	04/20/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK4.3	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK4.3	04/20/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK5.4	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK5.4	04/20/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK6.67	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK6.67	04/20/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK10.3	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK10.3	04/20/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK12.5	04/06/01	aqueous	ND	ND	ND	ND	ND	ND
SLOCK12.5	04/20/01	aqueous	ND	ND	ND	ND	ND	ND

a. BHC is equivalent to HCH

b. ND implies not detected; this detection limit is quantified in the Table-4 below.

Table 4. Detection limits and numeric objectives for water by constituent.

CONSTITUENT	BC LAB DETECTION LIMIT (µg/L)	BASIN PLAN OBJECTIVE (µg/L)	CTR- FRSHWTR AQUATIC^b (µg/L)	CTR MUN^c (µg/L)
ALPHA-BHC	0.0025	none	none	0.0039
BETA-BHC	0.0025	none	none	0.014
DELTA-BHC	0.0025	none	none	NONE
GAMMA-BHC	0.0025	4.0 ^a	0.95	0.019
CHLORDANE	0.05	0.1	2.4	0.00057
TOTAL PCB	0.1	0.3	none	0.00017

a. Basic plan objective for Lindane, which active ingredient is gamma-BHC.

b. California Toxics Rule (CTR) maximum concentration to protect freshwater aquatic organisms.

c. CTR concentration for 10⁻⁶ human risk of carcinogens for consumption of water or aquatic organisms.

The matrix of the data collected by CCAMP staff was fish tissue. Therefore the results of this data are gauged not by water quality objectives (as outlined in Table-4), but by tissue objectives listed as MTRLs. Table-5 below lists the results of the CCAMP sampling, as well as the numeric objectives that apply.

Table-5. 1999 CCAMP tissue data from San Luis Obispo Creek.

CONSTITUENT	MATRIX	CONCENTRATION (µg/Kg)	1995-1997 MTRL ^a (µg/L)
ALPHA-HCH	tissue	<1.0 ^b	1.7
BETA-HCH	tissue	<2.0	6.0
DELTA-HCH	tissue	<2.0	none
GAMMA-HCH	tissue	<1.0	8.2
CHLORDANE	tissue	2.0	8.3
TOTAL PCB	tissue	56.0	5.3

a. MTRLs are derived from California Toxic Rule water quality objectives.

b. An “<” indicates levels are at or below non-detection concentration.

5. HCH Results

Water quality objectives, as well as tissue residue objectives, for HCH are being met. Notice from Table-3 that the concentration of all species of HCH (listed as BHC) is non-detectable. The detection limit of the laboratory is lower than all the water quality objectives outlined in Table-4. Furthermore, the CCAMP tissue data (Table-5) show non-detect values that are lower than the MTRL objectives. Therefore, the water quality objectives outlined in the Basin Plan and CTR, as well as the objectives of the MTRL are met.

6. Chlordane Results

Chlordane concentrations in water samples are non-detectable, and fall below the MTRL objective. Table-3 and Table-4 illustrate that levels of chlordane are lower than the water quality objectives outlined in the Basin Plan, as well as the CTR objective for freshwater aquatic. However, the detection limit for chlordane is greater than the CTR MUN numeric objective. The actual concentration of chlordane in each sample could be lower than the CTR objective, including zero, but simply cannot be quantified below the laboratory detection limit. This uncertainty of the actual chlordane concentration is addressed in section “d” below. However, CCAMP data (Table-5) indicate levels of chlordane below the MTRL objective, and the MTRL objective is derived from CTR water quality objectives. Therefore, it can safely be stated that both water quality and tissue residue level objectives for chlordane are met.

7. PCB Results

The levels of PCB found in water samples collected in April 2001 are non-detectable, and like chlordane, the detection limit is less than the Basin Plan objective, but greater than the CTR objective. However, unlike chlordane, PCB concentrations in fish tissue collected by CCAMP (Table-5) are greater than the MTRL objective that is based on CTR. Therefore, the Basin Plan objective for PCB is met, but the CTR objective is not.

8. Discussion of Non-Detection Limits

The problem arises in that the laboratory reports non-detect for all constituents for all data points for the water quality samples collected in April 2001. However, the detection limit for chlordane and PCB is higher than the CTR objective for MUN. Therefore, the actual concentration of chlordane and PCB may or may not be lower than the CTR objective.

The CTR objectives for chlordane and PCB are based on laboratory experiments using rodents fed varying amounts of the pollutants. The amount of pollutant triggering a cancer is noted, then this amount is extrapolated to humans using an average adult human weight (70 kg) and average amount of water consumed each day (2 liters). The resulting numeric target (concentration of pollutant in water) is based on a 10^{-6} risk of a human contracting a cancer from the pollutant. In other words, the risk of an adult weighing 70 kg contracting a cancer, after drinking two liters of creek water each day contaminated at the specified numeric objective, is 1/1,000,000.

Note that the resulting numeric objective established does not address whether or not the concentration can be measured. On the contrary, a detection limit in the magnitude of parts per trillion would be necessary to meet the objective. Consider the following:

1. At this time, no conventional environmental laboratory is able to detect these pollutants at a level of parts per trillion.⁶
2. The laboratory detection limits listed in Table-4 are more sensitive than the standards outlined by the SWRCB that were established to implement the CTR.⁷ SWRCB mandates a laboratory have a maximum detect limit of 0.1 mg/L for chlordane, and 0.5 mg/L for PCB. The laboratory used by staff to analyze data collected in April 2001 has detection levels of 0.05 µg/L for chlordane and 0.1 µg/L for PCB. These detect levels are well within the state approved standards designed to comply with CTR.

3. Listing Clarification

Staff proposes to clarify the listing for San Luis Obispo Creek from its present listing of priority organics, to Polychlorinated biphenyl (PCB). This clarification, in effect, de-lists for HCH and chlordane and re-establishes the listing for PCB. This clarification is warranted for the following reasons.

⁶ Buttran, Steward. BC Laboratory of Bakersfield (Organics Supervisor). July 2001. Personal Communication.

⁷ State Water Resources Control Board, California Environmental Protection Agency. Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California. 2000.

b) HCH

Exceedence of an EDL for hexachlorocyclohexane was used as a basis for listing. However, since the listing, a determination has been made that EDLs cannot be used as listing rationale. Consider the following.

Staff considered de-listing factors identified in the 1998 Clean Water Act Section 303(d) Listing Guidelines for California, for adding or removing waterways from the 303(d) list (Ad Hoc Workgroup, 1997). These guidelines were developed by a workgroup of regional board, state board, and US EPA Region 9 staff and indicate that water bodies may be de-listed for specific pollutants or stressors if any one of six factors is met. These guidelines were considered by the Central Coast Regional Board, State Water Resources Control Board, and US EPA Region 9 during the public and administrative review and approval of the State's 303(d) List of Impaired Waters in 1998. The six de-listing factors are:

- a. Objectives are revised, and the exceedence is thereby eliminated.
- b. A beneficial use is de-designated after US EPA approval of a Use Attainability Analysis, and the non-support issue is thereby eliminated.
- c. Faulty data led to the initial listing. Faulty data include, but are not limited to typographical errors, improper quality assurance/quality control (QA/QC) procedures, or Toxic Substances Monitoring/State Mussel Watch EDLs that are not confirmed by risk assessment for human consumption.
- d. It has been documented that the objectives are being met and beneficial uses are not impaired based on "Monitored Assessment" criteria.
- e. A TMDL has been approved by the US EPA.
- f. There are control measures in place which will result in protection of beneficial uses. Control measures include permits, cleanup and abatement orders, and watershed management plans that are enforceable and include a time schedule.

Note that the data prompting the listing for HCH was from Toxic Substances Monitoring for which an EDL was exceeded. Factor-c above specifically eliminates the using EDLs that are not confirmed by risk assessment. In addition, recall that "they (EDLs) do not assess adverse impacts, nor do they necessarily represent concentrations that may be damaging to the mussels, clams, or to a human consuming these species."⁴ Therefore, the 1990 data point showing an exceedence of EDL-85 for HCH is considered faulty data, and should not be used as a rationale for listing.

The HCH concentration was reported as non-detect for all data points, and meets Basin Plan, CTR, and MTRL objectives. Therefore, objectives are met, beneficial uses are not impaired by HCH.

9. Chlordane

Results from data obtained in April 2001 show that levels of chlordane are at or below laboratory non-detection limits. The non-detect limits of the state-approved laboratory used to analyze the recent data are more sensitive (lower) than the standards set forth by the SWRCB.

Chlordane meets the MTRL objective, which is derived from the CTR-MUN objective. This, in effect, substantiates that neither tissue nor water quality objectives for chlordane are exceeded. Beneficial uses are therefore protected, and factor-d above has been satisfied.

10. PCB

Results from CCAMP monitoring indicate that the numeric objective of the MTRL for PCB in fish tissue is exceeded. However, results from water quality monitoring in April 2001 indicate PCB levels are non-detectable at detect levels approved by the state to meet CTR objectives. This inconsistency is indicative of how PCB behaves in the environment insofar its solubility in water diminishes over time, while it bioaccumulates in animals. For this reason, a clarification of the listing to PCB is necessary as well as warranted.